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(54) PRODUCTION METHOD OF LIGHT-REFLECTING COMPONENT

HERSTELLUNGSVERFAHREN FÜR LICHTREFLEKTIERENDES BAUELEMENT

PROCEDE DE FABRICATION D'UN ELEMENT REFLECHISSANT LA LUMIERE

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(73) Proprietor: **POLYPLASTICS CO. LTD.**
Chuo-Ku Osaka-shi Osaka 541 (JP)

(72) Inventors:
- **FUSAMOTO, Akira**
Shizuoka-ken 410 (JP)
- **TANIKITA, Masumi**
Tokyo 175 (JP)

(74) Representative: **Jackson, Peter**
Barker Brettell
10-12 Priests Bridge
London SW15 5JE (GB)

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Description

[0001] The present invention relates to a method of manufacturing resin components having a light reflector surface as well as to a light reflector component manufactured by the method.

[0002] The chief material of parts having a light reflective surface, such as lamp reflectors, has been changed from metal to synthetic resin. At present, most of such light reflector components include a base member composed of a bulk molding compound (hereinafter referred to as BMC) and an aluminium or another metal deposit or coat formed on the light-reflecting surface of the base member.

[0003] According to one proposed method of manufacturing a light reflector component, the base member is composed of a thermoplastic resin and the light-reflecting surface of the base member is coated with a metal. This method has been noted because of the good moldability and workability of thermoplastic resins and potential recovery and recycling of the resins.

[0004] Another method disclosed in JAPANESE PATENT PUBLICATION GAZETTE No. 3-45688 applies an aluminium sheet previously formed to a shape of reflective surface onto a base member.

[0005] United States patent No. 5 275 764 discloses a method for injection molding a lens panel of a lamp assembly, in particular a transparent lens for use in a motor vehicle tail lamp. The method comprises providing an injection mold having a female member and a male member to form at least one corrugated surface and at least one substantially flat surface; providing one or more differently coloured thin sheets of film; placing the thin sheet(s) of film between said male member and said female member; injecting a plastic into the mold to bond with the thin sheet(s) of film; and removing the resultant lamp assembly from the mold. Optionally one of the thin sheets of film can be of a reflective nature.

[0006] In the conventional method of manufacturing a light reflector component by making the base member out of a BMC and coating the light-reflecting surface of the base member with a metal, application of a primer is required prior to the process of coating the base member with a metal. The primer reduces the roughness of the light-reflecting surface so as to improve the reflecting properties and enhance the adhesive properties of the base member with the metal coating.

[0007] Thermoplastic coating material is generally used for the primer, which consumes time for the drying process. The liquid primer often causes sags after coating. As shown in Fig. 5, this may result in uneven coating of a primer 7 on the stepped portions and edges of a base member M, thereby lowering the accuracy of the shape of light reflective surface.

[0008] In the proposed method of manufacturing a light reflector component by making the base member out of a thermoplastic resin instead of the BMC and coating the light-reflecting surface of the base member with a metal, application of a primer is generally required prior to the process of coating the base member with a metal. This method is also not free from the drawbacks accompanied with the application of a primer as discussed above.

[0009] In the method of making the base member out of a thermoplastic resin, it is rather difficult to balance the properties required for light reflector components, that is, the heat resistance, strength, and rigidity, with the light reflecting properties. Variation in composition of the thermoplastic resin has been studied for improving the balance. The technique for enhancing the heat resistance, strength, and rigidity is generally in conflict with the technique for improving the light reflecting properties. No practical technique for settling the balance has been completed yet.

[0010] The method disclosed in JAPANESE PATENT PUBLICATION GAZETTE No. 3-45688 forms a thick coating, whose merit is that the-1-ight reflecting properties are not affected by the surface of resin components. For the small and simple-contoured components, such as stroboscopes for photography, no problems arise in the process of shaping an aluminium sheet to the light reflective surface. Components having the large and long light reflective surface of complicated shape, such as lamp reflectors of automobiles, have a problem of relatively low accuracy in shape, especially on the stepped portions and edges.

[0011] The object of the present invention is to provide a light reflector component manufactured by a simple process to have excellent reflecting properties and good heat resistance and mechanical properties. The invention provides a method of manufacturing an automobile lamp reflector component having a light reflective surface of concave shape, which includes the steps of: placing a thermoplastic resin film into a mold having a male and female element; and injecting a molten resin into a cavity of the mold to form a molded object having a layer of the thermoplastic resin film, characterised in that the male element of the mold has a surface shape corresponding to the desired concave shape of the light reflective surface, the resin film is preformed into the said concave shape, the preformed resin film is placed closely on to the male element of the mold, the molten resin is injected into a cavity of said mold defined by the female element and the preformed resin film so as to form a molded object comprising a base member of the injected resin with a concave surface and a uniform and integral layer of the resin film, and a light reflective surfaceis then formed on the resin film by coating it with a metal film. The resin film may be composed of any material selected among the group consisting of polycarbonates, thermoplastic polyesters, polyamides, poly(phenylene sulfides), polyarylates, and resins including any one of the preceding polymers as a main component.

[0012] The molten resin may be selected among the group consisting of poly(phenylene sulfides), thermoplastic polyesters, polyamides, and resins including any one of the preceding polymers as a main component, and it may comprise a bulk molding compound.

[0013] In the present invention, the film includes any thin plate-like sheets.

[0014] Preheating the thermoplastic resin film enhances the extensibility and flexibility thereof and allows the thermoplastic resin film to be formed into any complicated shape. The subsequent cooling process enables the thermoplastic resin film to maintain the rigidity while keeping the shape. Even in the case of deep drawing, a desired shape of a uniform thickness can be given to the thermoplastic resin film.

[0015] The light-reflecting surface of a part coated with a layer of the thermoplastic resin film is comparable to the surface formed by application of a primer. The method of the present invention does not require application of a primer but completes the excellent light reflective surface simply by coating the layer of the thermoplastic resin film on the light-reflecting surface of the part with a metal.

[0016] An appropriate amount of a primer may be applied with a view to enhancing the adhesive properties of the metal coating with the resin.

In the accompanying Drawings:

Fig. 1 shows a process of giving a shape of light reflective surface to a resin film;
Fig. 2 shows an exemplified process of producing a lamp reflector according to the method of the present invention;
Fig. 3 shows a light reflective surface composed of a resin film layer according to the invention; Fig. 4 shows a lamp reflector as a completed product according to the invention; and
Fig. 5 shows a conventional example processed with a primer according to the prior art.

[0017] Production of a lamp reflector for automobiles according to the method of the present invention is described with the accompanying drawings.

[0018] Numeral 1 represents a resin film. A shape corresponding to a concave light reflective surface of a lamp reflector for automobiles is given to the resin film 1.

[0019] Although material of the resin film used in the present invention is not specifically limited, preferable examples by taking into account the heat resistance and the optical properties include polycarbonates, thermoplastic polyesters, polyamides, poly(phenylene sulfides), polyarylates, and resins including any one of the preceding polymers as a main component. The preferable thickness of the film ranges from 0.1 to 0.5 mm.

[0020] In the embodiment, a polycarbonate resin film (0.3 mm in thickness) is used.

[0021] A desired shape is given to the resin film 1 by the process of vacuum forming in the embodiment. Referring to Fig. 1, the preheated resin film 1 is closely placed on a projection mold 2 corresponding to a shape of light reflective surface. After the resin film 1 is cured, the non-required periphery of the cured resin film 1 is trimmed to give a contoured resin film 1' having the concave shape.

[0022] The contoured resin film 1' of concave shape is set into an injection mold 3.

[0023] The injection mold 3 includes a male half 3a and a female half 3b and set in a clamp mechanism of an injection molding apparatus (not shown). The male half 3a has a protrusion element 4 corresponding to a shape of light reflective surface of a final product, that is, a lamp reflector, is formed on the male half 3a, whereas the female half 3b has a concave element 5 corresponding to a shape of rear surface of the lamp reflector.

[0024] The contoured resin film 1' is set in the open mold 3 to come into close contact with the protrusion element 4 of the male half 3a (see Fig. 2(a)).

[0025] After the contoured resin film 1' is set in the mold 3, the mold 3 is closed and a molten resin 6 is injected into a space defined by the male half 3a and the female half 3b (see Fig. 2(b)).

[0026] Although the resin injected into the mold for the above purpose in the present invention is not specifically limited, preferable examples by taking into account the heat resistance, mechanical properties, dimensional stability, and moisture resistance include thermoplastic resins, such as poly(phenylene sulfides), thermoplastic polyesters, polyamides, and resins including any one of the preceding polymers as a main component.

[0027] Another preferable example is BMCs including a thermosetting resin, such as an unsaturated polyester resin, as the resin base.

[0028] Molten resins applied in the embodiment include one obtained by mixing 40% by weight of glass fibers with a poly(phenylene sulfide), one obtained by mixing 30% by weight of glass fibers with a poly(butylene terephthalate), which is one of the thermoplastic polyesters, and a BMC including an unsaturated polyester resin as the resin base.

[0029] After the resin composition is cooled and cured, a resulting molded object is removed from the mold. The molded object has a uniform and integral layer of the contoured resin film 1' formed on the concave surface of a base member M in the shape of a lamp reflector. The layer of the contoured resin film 1' has a fine surface roughness and a high dimensional accuracy (see Fig. 3).

[0030] Deposition of aluminum onto the concave surface gives a lamp reflector having a light reflective surface F

with high imaging properties (see Fig. 4).

[0031] The resin film layer is integrally formed on the concave surface of the base member, which is favorable for the light reflecting properties. The concave surface coated with the resin film layer is not affected by the surface properties of the base member. Inexpensive materials even with poor surface roughness may accordingly be used for the resin composition of the base member, as long as it has sufficient heat resistance, mechanical strength, and dimensional accuracy. A filler may be mixed with the resin composition according to the requirements.

[0032] This structure realizes a light in weight, thin-walled base member and allows a variation in resin composition for the purpose of reinforcing the base member without taking into account the surface properties of the modified composition. Since the degree of freedom is increased for the selection of material, resin components of such structure may go into a wide range of novel applications.

[0033] As is generally known, surface treatment, such as irradiation of an ultraviolet ray or plasma processing, enhances the adhesive properties of the concave surface coated with an aluminum deposit. Surface treatment of the resin film layer of the embodiment resulted in a significant improvement in adhesive properties of the base member with aluminum.

[0034] Table 1 shows the results of a peel test of the aluminum deposit and evaluation of the imaging properties.

[0035] The peel test was carried out in the following manner. Each test piece having a resin film layer integrally formed on the surface of a flat plate composed of a base resin (containing 30% by weight of glass fibers) was prepared by the process of insert molding. Aluminum was deposited on the surface of resin film (thickness of deposit: 1,000 angstrom). The peeling properties of the aluminum deposit were evaluated by the 2 mm-squares tape peel test. The results of the peel test and the imaging properties at the time of peel test are tabulated.

[0036] For the purpose of comparison, the similar test was performed for BMC base members without a film and PPS base members without a film.

[0037] The results of the peel test are expressed as the number of peeled deposits per 100 test pieces.

[0038] These results showed that the resin film integrally formed on the surface of the base member significantly improved the adhesive properties and imaging properties of the metal deposit.

TABLE XX1

BASE MATERIAL	FILM (*1)	DEPOSIT PEEL TEST	IMAGING PROPERTY (*2) (%)
PPS	PET	0/100	84.3
PPS	PC	0/100	93.6
PPS	PAR	0/100	90.5
PPS	PA	0/100	80.3
PPS	PPS	2/100	80.8
PET	PC	0/100	94.1
PA	PC	0/100	93.0
BMC	PC	0/100	93.8
BMC	NONE	45/100	67.2
PPS	NONE	35/100	70.8

*1: No primer

*2: Mapping property meter (manufactured by Suga Shikenki)

PPS: poly(phenylene sulfide)

PBT: poly(butylene terephthalate)

PA : polyamide

PET: poly(ethylene terephthalate)

PC : polycarbonate

PAR: polyacrylate

BMC: bulk molding compound

[0039] Although-the above embodiment refers to a lamp reflector for automobiles, the light reflector component of the present invention may be applicable to stroboscopes for photography, searchlights, and light sources of optical equipment. The thermoplastic resin sheet and the coating metal are not limited to those in the above embodiment.

[0040] The light reflective surface may have a convex shape, a flat shape, or any desirable complicated shape other than the concave shape of the embodiment.

[0041] The method of the present invention integrally forms a resin film layer on the light-reflecting surface of a base

member, thereby not requiring application of a primer, which has conventionally been applied prior to the metal coating process. The structure of the present invention thus effectively solves the problem of the conventional structure. Since the surface properties of the light reflective surface are favorably kept by the resin film layer, a desirable resin composition having sufficient heat resistance, mechanical strength, and dimensional accuracy may be freely selected as the base member without taking into account the surface properties of the resin composition.

[0042] The thermoplastic resin film having the shape of light reflective surface is securely joined with the light-reflecting surface of a base member. This structure ensures a high accuracy of the resulting light reflective surface and is suitably applicable to lamp reflectors having a large and long light reflective surface of complicated shape.

Claims

1. A method of manufacturing an automobile lamp reflector component having a light reflective surface (F) of concave shape, said method comprising the steps of placing a thermoplastic resin film (1) into a mold (3) having a male element (4) and a female element (5) and injecting a molten resin (6) into a cavity of said mold (3) to form a molded object having a layer of said thermoplastic resin film (1), **characterised in that** the male element (4) of the mold (3) has a surface shape corresponding to the desired concave shape of the light reflective surface (F), the resin film (1) is preformed into the said concave shape, the preformed resin film (1') is placed closely on to the male element (4) of the mold (3), the molten resin (6) is injected into a cavity of said mold defined by the female element (5) and the preformed resin film (1') so as to form a molded object comprising a base member (M) of the injected resin with a concave surface and a uniform and integral layer of the resin film (1'), and a light reflective surface (F) is then formed on the resin film by coating it with a metal film.

2. A method in accordance with claim 1, wherein said resin film (1) is composed of any material selected among the group consisting of polycarbonates, thermoplastic polyesters, polyamides, poly(phenylene sulfides), polyarylates, and resins comprising any one of the preceding polymers as a main component.

3. A method in accordance with either one of claims 1 and 2, wherein said molten resin (6) is selected among the group consisting of poly(phenylene sulfides), thermoplastic polyesters, polyamides, and resins comprising any one of the preceding polymers as a main component.

4. A method in accordance with either one of claims 1 and 2, wherein said molten resin (6) comprises a bulk molding compound.

Patentansprüche

1. Verfahren zur Herstellung einer Kraftfahrzeugleuchten-Reflektorkomponente mit einer lichtreflektierenden Fläche (F) mit konkaver Form, wobei das Verfahren die Schritte des Anordnens einer Folie (1) aus einem thermoplastischen Harz in einer Form (3) mit einem Stempelelement (4) und einem Gesenkelement (5) und das Einspritzen eines geschmolzenen Harzes (6) in einen Hohlraum der Form (3) zur Bildung eines Formteils mit einer Schicht aus der thermoplastischen Harzfolie (1) umfasst, **dadurch gekennzeichnet, dass** das Stempelelement (4) der Form (3) eine Oberflächenform hat, die der gewünschten konkaven Form der lichtreflektierenden Fläche (F) entspricht, die Harzfolie (1) zur konkaven Form vorgeformt ist, die vorgeformte Harzfolie (1') nah am Stempelelement (4) der Form (3) angeordnet ist, das geschmolzene Harz (6) in einen durch das Gesenkelement (5) und die vorgeformte Harzfolie (1') definierten Hohlraum unter Bildung eines Formteils eingespritzt wird, das ein Sockelelement (M) des eingespritzten Harzes mit einer konkaven Fläche und eine gleichmäßige und integrale Schicht aus der Harzfolie (1') umfasst, und dann eine lichtreflektierende Fläche (F) auf der Harzfolie gebildet wird, indem sie mit einem Metallfilm beschichtet wird.

2. Verfahren nach Anspruch 1, wobei die Harzfolie (1) aus einem beliebigen Material besteht, das aus der Gruppe bestehend aus Polycarbonaten, thermoplastischen Polyestern, Polyamiden, Poly(phenylensulfiden), Polyacrylaten und Harzen, die eines der vorhergehenden Polymere als Hauptbestandteil enthalten, ausgewählt ist.

3. Verfahren nach einem der Ansprüche 1 und 2, wobei das geschmolzene Harz (6) aus der Gruppe bestehend aus Poly(phenylensulfiden), thermoplastischen Polyestern, Polyamiden und Harzen, die eines der vorhergehenden Polymere als Hauptbestandteil enthalten, ausgewählt ist.

4. Verfahren nach einem der Ansprüche 1 und 2, wobei das geschmolzene Harz (6) eine nicht flächenförmige, teigartige Pressmasse umfasst.

Revendications

1. Procédé de fabrication d'un composant de réflecteur de phare d'automobile présentant une surface réfléchissant la lumière (F) de forme concave, ledit procédé comprenant les étapes consistant à placer un film de résine thermoplastique (1) dans un moule (3) comportant un élément mâle (4) et un élément femelle (5), et à injecter une résine fondue (6) dans une cavité dudit moule (3) afin de former un objet moulé comportant une couche dudit film de résine thermoplastique (1), **caractérisé en ce que** l'élément mâle (4) du moule (3) présente une forme de surface correspondant à la forme concave souhaitée de la surface réfléchissant la lumière (F), le film de résine (1) est préformé suivant ladite forme concave, le film de résine préformé (1') est placé étroitement sur l'élément mâle (4) du moule (3), la résine fondue (6) est injectée dans une cavité dudit moule défini par l'élément femelle (5) et le film de résine préformé (1') de façon à former un objet moulé comprenant un élément de base (M) de la résine injectée présentant une surface concave et une couche uniforme et intégrale du film de résine (1'), et une surface réfléchissant la lumière (F) est ensuite formée sur le film de résine en le revêtant d'un film métallique.

2. Procédé selon la revendication 1, dans lequel ledit film de résine (1) est composé d'un matériau quelconque choisi parmi le groupe constitué de polycarbonates, de polyesters thermoplastiques, de polyamides, de poly(sulfures de phénylène), de polyarylates, et de résines comprenant n'importe lequel des polymères précédents en tant que constituant principal.

3. Procédé selon l'une ou l'autre des revendications 1 et 2, dans lequel ladite résine fondue (6) est choisie parmi le groupe constitué de poly(sulfures de phénylène), de polyesters thermoplastiques, de polyamides, et de résines comprenant n'importe lequel des polymères précédents en tant que constituant principal.

4. Procédé selon l'une ou l'autre des revendications 1 et 2, dans lequel ladite résine fondue (6) comprend un prémélange.

Fig. 1

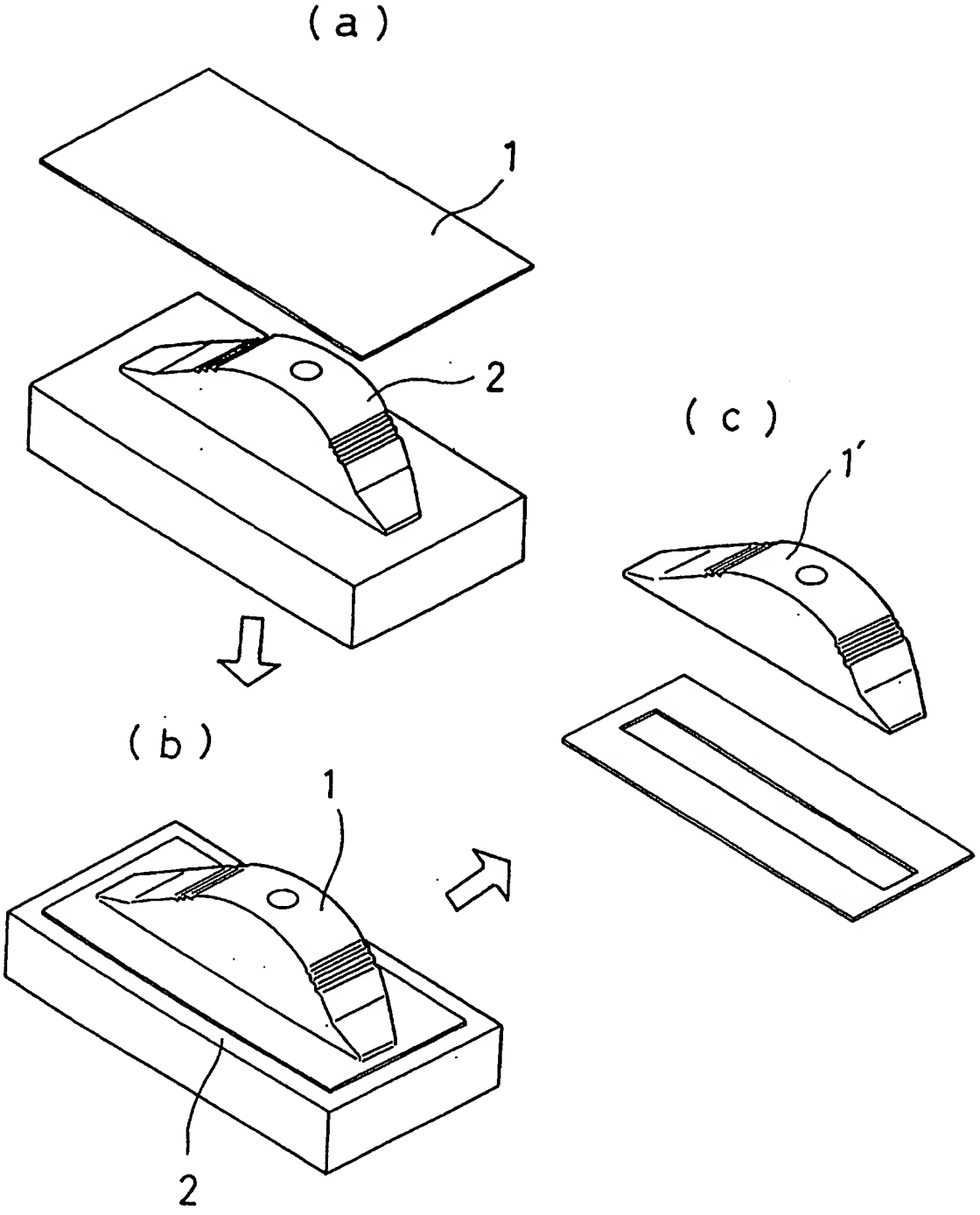

Fig. 2

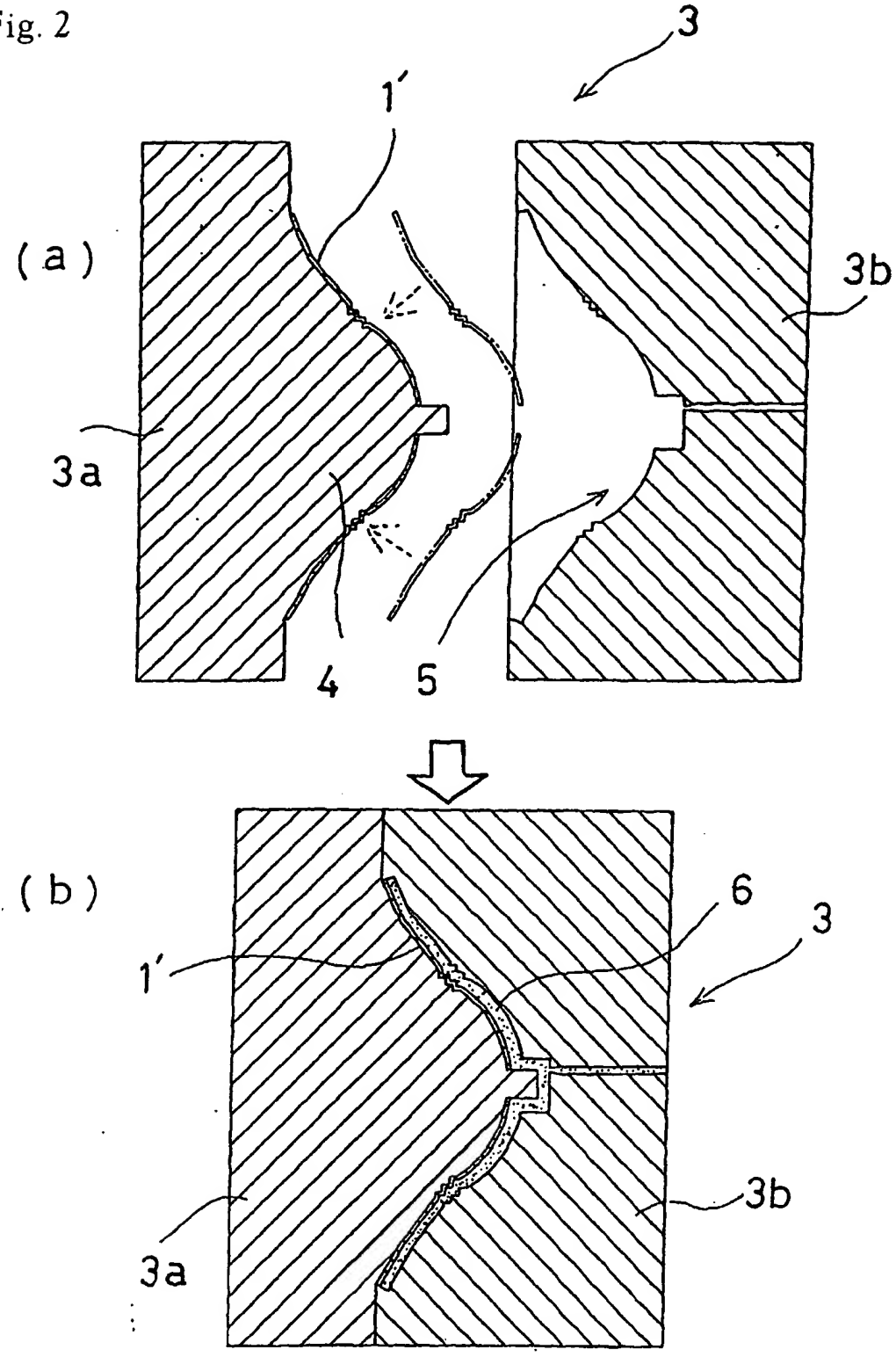

Fig. 3

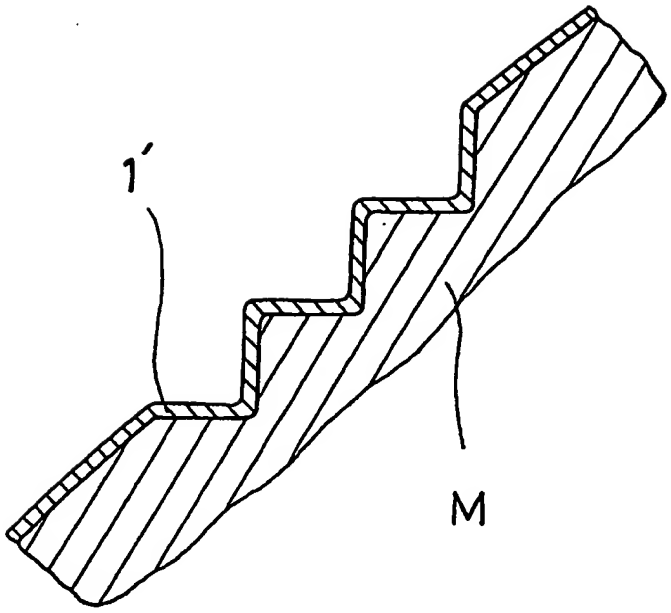

Fig. 4

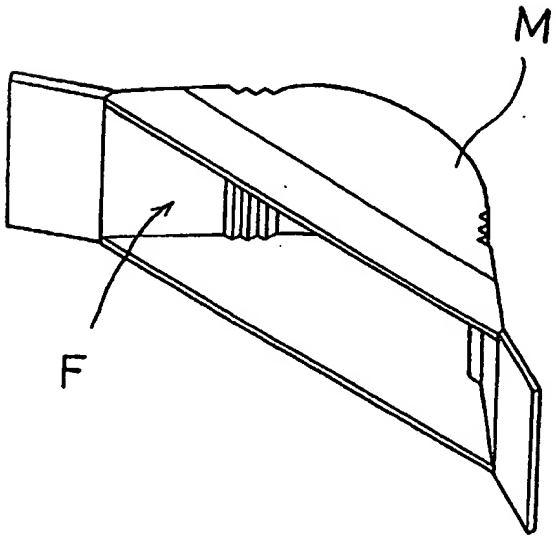

Fig. 5